

## Echinoderm Fauna of Chuuk, The Federated States of Micronesia

Taekjun Lee<sup>1</sup>, Sook Shin<sup>2,\*</sup>

<sup>1</sup>College of Life Sciences and Biotechnology, Korea University, Seoul 136-701, Korea

<sup>2</sup>Department of Life Science, Sahmyook University, Seoul 139-742, Korea

### ABSTRACT

Micronesia is an island nation located north of Papua New Guinea in the Pacific Ocean. A survey was conducted on Chuuk, which is one of the four main islands of Micronesia, from 11–25 Nov 2012. Echinoderms collected at one intertidal area as well as at 16 SCUBA diving points of 10–40 m depths in the subtidal zone were identified based on morphological characteristics. In total, 35 species from 165 individuals were identified: two crinoids, eight asteroids, four ophiuroids, seven echinoids, and 14 holothuroids. Among them, one asteroid, one ophiuroid, one echinoid, and two holothuroids were newly recorded from Micronesia.

**Keywords:** taxonomy, Echinodermata, fauna, Chuuk, Micronesia

### INTRODUCTION

The Federated States of Micronesia (FSM) consists of four island states in the North Pacific Ocean, including Pohnpei, Chuuk, Yap, and Kosrae, totaling 607 small islands (65 inhabited), extending 2,900 km across the Caroline Islands, from Kosrae in the east to Yap in the west. Chuuk is situated at about 7°08' and 7°41'N latitude and 151°26' and 152°2'E longitude in the western Pacific and includes 12 volcanic high islands, 24 low coral-reef islands in a lagoon enclosed by a barrier reef forming a near-atoll, and 41 low coral islands along the atoll (Rehman et al., 2013). Specific information on the echinoderm fauna of Chuuk, Micronesia has been described in reports by Kerr (1994), Kerr et al. (2007, 2008), Korea Institute of Ocean Science and Technology (KIOST, 2009), and Lee and Shin (2013). We surveyed the echinoderm fauna at one intertidal site and 16 SCUBA diving points around Chuuk and assembled a checklist of echinoderms of this island.

### MATERIALS AND METHODS

We collected echinoderms at 17 sites in Chuuk from 11–25 Nov 2012 (Table 1, Fig. 1). One intertidal zone of Weno

Island was coral sand and rocky, and other 16 subtidal zones were investigated by SCUBA diving at depths of 10–40 m. The GPS coordinates and depth of each site were recorded (Table 1). All collected specimens were preserved in 95% ethyl alcohol and were identified based on their morphological characteristics. Important morphological characteristics and live conditions were photographed by a digital camera (Nikon D7000; Nikon Co., Tokyo, Japan), stereo- and light-microscopes (Nikon SMZ1000, Eclipse 80i), and scanning electron microscope (JSM-6510; JEOL, Tokyo, Japan). These specimens were identified mainly based on AM Clark and Rowe (1971) and Lee and Shin (2013). Specimens were deposited in the Marine Echinoderm Resource Bank of Korea (MERBK), Sahmyook University, Seoul, Korea.

### RESULTS

A total of 165 specimens collected for the echinoderm faunistic study of Chuuk were identified as 35 species in 28 genera: two crinoids, eight asteroids, four ophiuroids, seven echinoids, and 14 holothuroids. Of these, five echinoderms including one asteroid (*Gomophia egyptiaca* Gray, 1840), one ophiuroid (*Ophionereis porrecta* Lyman, 1860), one echinoid [*Schizaster lacunosus* (Linnaeus, 1758)], and two holothu-

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

**\*To whom correspondence should be addressed**  
Tel: 82-2-3399-1717, Fax: 82-2-3399-1729  
E-mail: shins@syu.ac.kr

**Table 1.** Geological information for collection sites around Chuuk

Station	Collection site	Date	GPS	Max. of depth (m)
1	Weno Island Intertidal	12, 13, 15, 17 Nov 2012	7° 27'14"N, 151° 53'53"E	8
2	Mokumok Island Diving	13 Nov 2012	7° 24'26"N, 151° 52'59"E	40
3	Benedict Diving	13 Nov 2012	7° 27'06"N, 151° 54'26"E	40
4	Ferit Island Diving	14 Nov 2012	7° 25'48"N, 151° 55'52"E	16
5	Sand Island Diving	14 Nov 2012	7° 28'58"N, 151° 49'39"E	18
6	Atoll Diving-1	16 Nov 2012	7° 14'35"N, 151° 36'56"E	30
7	Atoll Diving-2	16 Nov 2012	7° 13'53"N, 151° 38'34"E	25
8	Holap Diving	17 Nov 2012	7° 38'49"N, 151° 53'23"E	35
9	Atoll Diving-3	19 Nov 2012	7° 38'55"N, 151° 53'15"E	30
10	Atoll Diving-4	19 Nov 2012	7° 40'18"N, 151° 49'44"E	32
11	Atoll Diving-5	19 Nov 2012	7° 40'40"N, 151° 47'43"E	30
12	Atoll Diving-6	20 Nov 2012	7° 39'02"N, 151° 41'03"E	34
13	Atoll Diving-7	20 Nov 2012	7° 40'16"N, 151° 45'28"E	40
14	Atoll Diving-8	21 Nov 2012	7° 20'55"N, 151° 59'26"E	30
15	Atoll Diving-9	21 Nov 2012	7° 27'06"N, 151° 59'03"E	32
16	Atoll Diving-10	21 Nov 2012	7° 31'32"N, 151° 58'03"E	30
17	Xavier school Diving	22 Nov 2012	7° 24'56"N, 151° 54'09"E	37

**Fig. 1.** A map showing the collection sites in Chuuk.

roids (*Opheodesoma spectabilis* Fisher, 1907 and *Thelenotaxanax* H.L. Clark, 1921) which were marked with asterisks in the following list, were newly recorded on Micronesia and described with brief remarks.

Phylum Echinodermata Klein, 1734  
 Subphylum Crinozoa Matsumoto, 1929  
 Class Crinoidea Müller, 1821  
 Order Comatulida AH Clark, 1908  
 Family Comasteridae AH Clark 1908

Subfamily Comasterinae AH Clark, 1909

Genus *Comaster* L. Agassiz, 1836

### 1. *Comaster schlegelii* (Carpenter, 1881)

**Material examined.** 1 specimen, Ferit Island diving, 14 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Palau, Guam, South Pacific, northern Australia, Indo-West Pacific, Bengal Bay.

Genus *Oxycomanthus* Rowe, Hoggett, Birtles and Vail, 1986

### 2. *Oxycomanthus bennetti* (Müller, 1841)

**Material examined.** 1 specimen, Holap diving, 17 Nov 2012; 1 specimen, Atoll diving-3, 19 Nov 2012; 1 specimen, Atoll diving-6, 20 Nov 2012; 1 specimen, Atoll diving-8, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), southern Japan, southern China, Philippines, Palau, Guam, South Pacific, northern Australia, Indo-West Pacific, Bengal Bay.

Subphylum Asterozoa von Zittel, 1895

Class Asteroidea de Blainville, 1830

Order Valvatida Perrier, 1884

Family Acanthasteridae Sladen, 1889

Genus *Acanthaster* Gervais, 1841

### 3. *Acanthaster planci* (Linnaeus, 1758)

**Material examined.** 1 specimen, Atoll diving-8, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), Guam, Palau, New Zealand (Kermadec Islands), Indo-West Pacific, eastern Africa (Mauritius, Madagascar), Red Sea.

Family Ophiasteridae Verrill, 1870  
Genus *Gomophia* Gray, 1840

**\*4. *Gomophia egyptiaca* Gray, 1840 (Fig. 3A–C)**

*Gomophia egyptiaca* Gray, 1840: 286; AH Clark, 1954: 255; AM Clark and Rowe, 1971: 64; Yamaguchi, 1975: 14; Tortonese, 1977: 276; Mah, 2014: 213303.  
*Nardoa aegyptiaca*: Fisher, 1919: 382.

**Material examined.** 1 specimen, Mokumok Island diving, 13 Nov 2012; 1 specimen, Sand Island diving, 14 Nov 2012.

**Distribution.** Micronesia (Chuuk), southern Japan, China, northern Australia, Indo-West Pacific, Red Sea.

**Remarks.** Body color is scarlet, and yellowish irregular patterns are on dorsal, lateral, and ventral sides of arms.

Genus *Linckia* Nardo, 1834

**5. *Linckia laevigata* (Linnaeus, 1758) (Fig. 2A)**

**Material examined.** 1 specimen, Sand Island diving, 14 Nov 2012; 1 specimen, Atoll diving-2, 16 Nov 2012; 1 specimen, Atoll diving-3, 19 Nov 2012; 1 specimen, Atoll diving-8, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), Korea (Jeju Island), Japan, southern China, Taiwan, Hong Kong, Guam, Hawaii, Australia, Indo-West Pacific, eastern Africa (Mauritius, Madagascar, Mozambique, Tanzania), Red Sea.

**6. *Linckia multifora* (Lamarck, 1816) (Fig. 2B, C)**

**Material examined.** 1 specimen, Weno Island intertidal, 12 Nov 2012; 1 specimen, Mokumok Island diving, 13 Nov 2012; 2 specimens, Weno Island intertidal, 13 Nov 2012; 1 specimen, Ferit Island diving, 14 Nov 2012; 3 specimens, Sand Island diving, 14 Nov 2012; 2 specimens, Weno Island intertidal, 15 Nov 2012; 1 specimen, Weno Island intertidal, 17 Nov 2012; 1 specimen, Holap diving, 17 Nov 2012; 1 specimen, Atoll diving-5, 19 Nov 2012; 1 specimen, Atoll diving-7, 20 Nov 2012; 2 specimens, Atoll diving-8, 21 Nov 2012; 2 specimens, Xavier school diving, 22 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern China, Guam, Australia, Indo-West Pacific, eastern Africa (Madagascar), Red Sea.

Family Goniasteridae Forbes, 1841  
Genus *Fromia* Gray, 1840

**7. *Fromia nodosa* AM Clark, 1967**

**Material examined.** 1 specimen, Atoll diving-6, 20 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), Sri Lanka (Ceylon), West Indian Ocean (Amirante Island, Maldives Island), Eastern Africa (Aldabra Atoll, Seychelles).

Family Oreasteridae Fisher, 1911  
Genus *Choriaster* Lütken, 1869

**8. *Choriaster granulatus* Lütken, 1869 (Fig. 2D)**

**Material examined.** 1 specimen, Sand Island diving, 14 Nov 2012; 1 specimen, Atoll diving-1, 16 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Guam, Palau, New Caledonia, Indo-West Pacific, eastern Africa, Red Sea.

Genus *Culcita* (L. Agassiz, 1836)

**9. *Culcita novaeguineae* Müller and Troschel, 1842 (Fig. 2E, F)**

**Material examined.** 1 specimen, Weno Island intertidal, 13 Nov 2012; 1 specimen, Weno Island intertidal, 17 Nov 2012; 1 specimen, Holap diving, 17 Nov 2012; 1 specimen, Atoll diving-5, 19 Nov 2012; 1 specimen, Atoll diving-6, 20 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Guam, Palau, Marshall Islands, Hawaii, northern Australia, Bengal Bay, Indo-West Pacific, eastern Africa (Madagascar, Mozambique).

Order Spinulosida Perrier, 1884  
Family Echinasteridae Verrill, 1867  
Genus *Echinaster* Müller and Troschel, 1840

**10. *Echinaster luzonicus* (Gray, 1840)**

**Material examined.** 1 specimen, Benedict diving, 13 Nov 2012; 1 specimen, Weno Island intertidal, 13 Nov 2012; 1 specimen, Holap diving, 17 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Guam, Palau, South Pacific, northern Australia, New Caledonia.

Class Ophiuroidea Gray, 1840  
Order Ophiurida Müller and Troschel, 1840  
Infraorder Gnathophiurina Matsumoto, 1915  
Family Ophiactidae Matsumoto, 1915  
Genus *Ophiactis* Lütken, 1856

**11. *Ophiactis savignyi* (Müller and Troschel, 1842)**

**Material examined.** 7 specimens, Mokumok Island diving, 13 Nov 2012; 5 specimens, Ferit Island diving, 14 Nov 2012; 2 specimens, Holap diving, 17 Nov 2012; 4 specimens, Atoll diving-8, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), Korea (Korea Strait, Jeju Island), Japan (Honshu, Kyushu), China, Philippines, Guam, northern Australia, Singapore, Indo-West Pacific, eastern Africa (Tanzania, Madagascar), Red Sea, Mediterranean Sea, Atlantic Ocean.

Family Ophicomidae Ljungman, 1867

Genus *Ophiocoma* L Agassiz, 1835

**12. *Ophiocoma erinaceus* Müller and Troschel, 1842 (Fig. 2G)**

**Material examined.** 1 specimen, Weno Island intertidal, 12 Nov 2012; 1 specimen, Weno Island intertidal, 15 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Guam, Hawaii, South Pacific, northern Australia, Indo-West Pacific, eastern Africa, Red Sea.

Family Ophionereididae Ljungman, 1867

Genus *Ophionereis* Lütken, 1859

**\*13. *Ophionereis porrecta* Lyman, 1860 (Fig. 3D–G)**

*Ophionereis porrecta* Lyman, 1860: 260; AH Clark, 1954: 259; Starmer, 2003: 555; Stöhr, 2011: 35; Stöhr and O'Hara, 2014: 213419.

*Ophionereis squamata* Ljungman, 1867: 310.

*Ophionereis crassispina* Ljungman, 1867: 311.

*Ophionereis sophiae* Brock, 1888: 490.

**Material examined.** 1 specimen, Ferit Island diving, 14 Nov 2012.

**Distribution.** Micronesia (Chuuk), Saipan, Guam, Mariana Islands, Indo-West Pacific, eastern Africa (Madagascar, Tanzania), Red Sea.

**Remarks.** This species was collected inside hole of the sponge. Disk color is pale brown, and pale brown line is represented along width of arm.

Family Ophiotrichidae Ljungman, 1867

Genus *Ophiotrix* Müller and Troschel, 1840

**14. *Ophiotrix (Acanthophiotrix) purpurea* von Martens, 1867 (Fig. 2H)**

**Material examined.** 1 specimen, Holap diving, 17 Nov 2012;

2 specimens, Atoll diving-10, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), southern China, Guam, Indo-West Pacific, eastern Africa (Madagascar, Tanzania), Red Sea.

Subphylum Echinozoa

Class Echinoidea Leske, 1778

Order Diadematoida Duncan, 1889

Family Diadematidae Gray, 1855

Genus *Echinothrix* Peters, 1853

**15. *Echinothrix diadema* (Linnaeus, 1758)**

**Material examined.** 1 specimen, Benedict diving, 13 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Guam, Hawaii, South Pacific, northern Australia, Indo-West Pacific, eastern Africa, Red Sea.

Order Camarodonta Jackson, 1912

Family Temnopleuridae A Agassiz, 1872

Genus *Mespilia* Desor, 1846

**16. *Mespilia globulus* (Linnaeus, 1758) (Fig. 2I, J)**

**Material examined.** 2 specimens, Weno Island intertidal, 12 Nov 2012; 3 specimens, Weno Island intertidal, 15 Nov 2012; 1 specimen, Weno Island intertidal, 17 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), Korea (Jeju Island), southern Japan, southern China, Philippines, Guam, Hawaii, South Pacific, northern Australia, Indo-West Pacific, eastern Africa, Red Sea.

Family Parasalenidae Mortensen, 1903

Genus *Parasalenia* A Agassiz, 1863

**17. *Parasalenia gratiosa* A Agassiz, 1863 (Fig. 2L)**

**Material examined.** 2 specimens, Weno Island intertidal, 12 Nov 2012; 1 specimen, Ferit Island diving, 14 Nov 2012; 3 specimens, Weno Island intertidal, 15 Nov 2012; 1 specimen, Weno Island intertidal, 17 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), southern China, Guam, Indo-West Pacific, eastern Africa (Kenya, Madagascar, Mozambique), Red Sea.

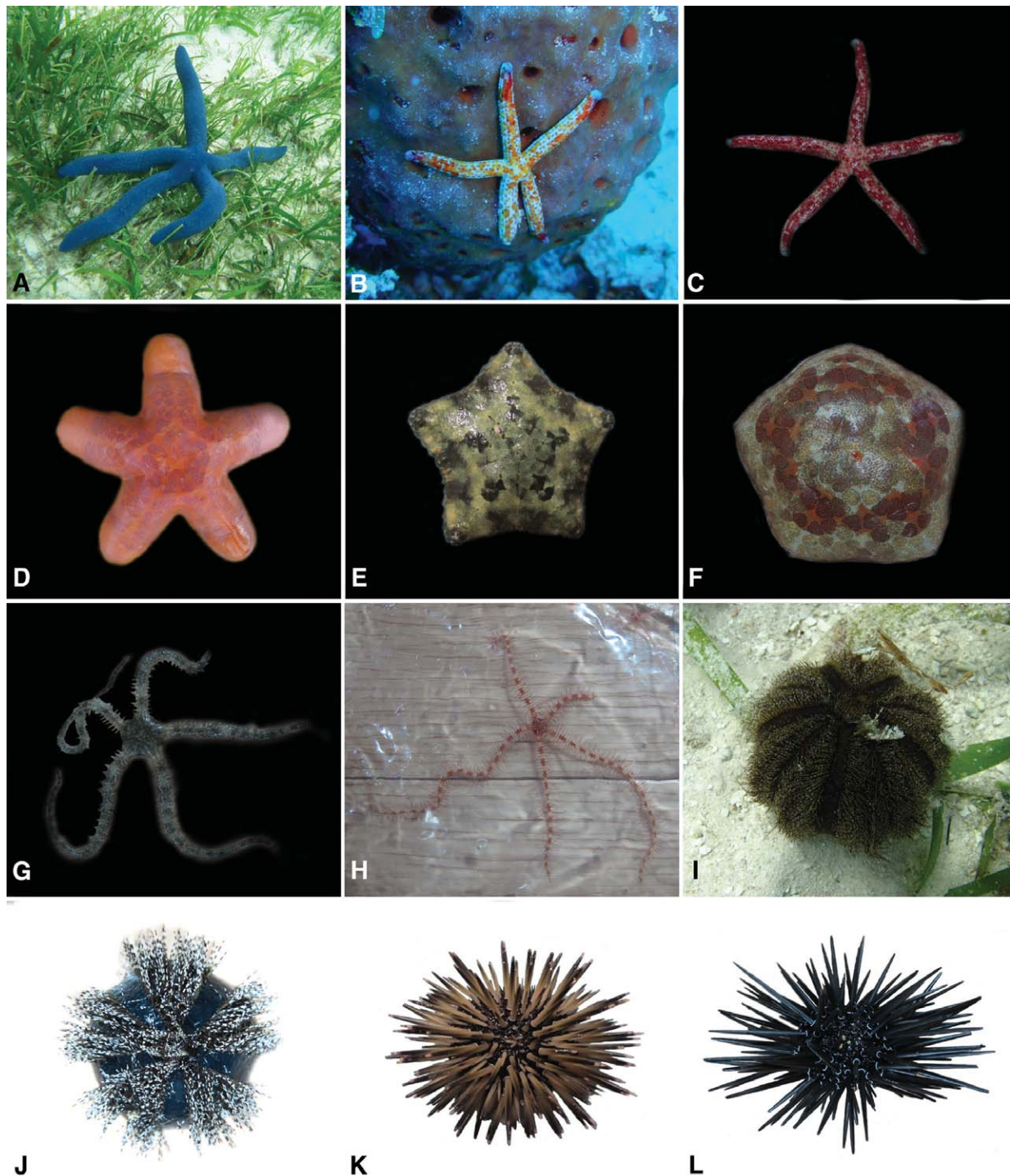
Family Echinometridae Gray, 1855

Genus *Echinostrephus* A Agassiz, 1863

**18. *Echinostrephus aciculatus* A Agassiz, 1863**

**Material examined.** 1 specimen, Benedict diving, 13 Nov





**Fig. 2.** Some echinoderms from Chuuk. A, *Linckia laevigata*; B, C, *L. multifora*; D, *Choriaster granulatus*; E, *Culcita novaeguineae* (young); F, *C. novaeguineae* (adult); G, *Ophiocoma erinaceus*; H, *Ophiothrix* (*Acanthophiothrix*) *pupurea*; I, J, *Mespila globulus*; K, *Echinometra mathaei*; L, *Parasalenia gratiosa*.

2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Taiwan, East Australia, Indo-West

Pacific.

Genus *Echinometra* Gray, 1825

**19. *Echinometra mathaei* (Blainville, 1825) (Fig. 2K)**

**Material examined.** 1 specimen, Weno Island intertidal, 13 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), Korea (Jeju Island), southern Japan, southern China, Philippines, Guam, Solomon Islands, Hawaii, North Australia, Indo-West Pacific, Red Sea, eastern Africa.

Order Clypeasteroidea L Agassiz, 1835  
Family Laganidae L Agassiz, 1835  
Genus *Laganum* Link, 1807

**20. *Laganum laganum* (Leske, 1778) (Fig. 3H, I)**

**Material examined.** 2 specimens, Weno Island intertidal, 12 Nov 2012.

**Distribution.** Micronesia (Chuuk), southern Japan, southern China, Philippines, Hawaii, South Pacific, northern Australia, Indo-West Pacific, West Indian Ocean, eastern Africa.

Order Spatangoida L Agassiz, 1840  
Family Schizasteridae Lambert, 1905  
Genus *Schizaster* L Agassiz, 1836

**\*21. *Schizaster lacunosus* (Linnaeus, 1758) (Fig. 3J–L)**  
*Echinus lacunosus* Linnaeus, 1758: 665.

*Schizaster japonicus*: A Agassiz, 1879: 212; 1881: 202, Pl. 36, figs. 8–13, Pl. 43, figs. 7–10; Döderlein, 1885: 109; A Agassiz and HL Clark, 1907: 137.

*Schizaster lacunosus*: Mortensen, 1907: 120; HL Clark, 1917: 193; Mortensen, 1951: 300, Pl. 21, figs. 5–10, 14–18, Pl. 54, figs. 1–3, 5, 7–9, 12, 14–17, text-figs. 140a, b; AM Clark and Rowe, 1971: 146, 166; Rho and Shin, 1981: 35, Pl. 11, figs. 1–5; Shin, 2011: 98; Kroh and Mooi, 2014: 214662.

**Material examined.** 1 specimen, Sand Island diving, 14 Nov 2012.

**Distribution.** Micronesia (Chuuk), Korea (Korea Strait, Jeju Island), Japan (Sagami Bay-Kagoshima Bay), East China Sea, Hong Kong, Arafura Sea, northern Australia, Indo-West Pacific, East Africa.

**Remarks.** This species was found at the Korea Strait and Jeju Island of South Korea, and it is widely distributed in sub-tropical and tropical regions from the Pacific to Atlantic. Naked test collected at depth of 13 m and covered with coral sand.

Class Holothuroidea de Blainville, 1834  
Order Apodida Brandt, 1835  
Family Synaptidae Burmeister, 1837

Genus *Opheodesoma* Fisher, 1907

**\*22. *Opheodesoma spectabilis* Fisher, 1907 (Fig. 4A–C)**  
*Opheodesoma spectabilis* Fisher, 1907: 723; HL Clark, 1924: 467; Domantay, 1954: 354; AM Clark and Rowe, 1971: 186; Paulay, 2014: 210712.

**Material examined.** 1 specimen, Weno Island intertidal, 17 Nov 2012.

**Distribution.** Micronesia (Chuuk), Guam, Hawaii, Philippines, Indo-West Pacific, eastern Africa (Kenya, Madagascar), Red Sea.

**Remarks.** This species was collected at sea grass region. Body color was dark reddish brown. Morphological characteristics of ossicles are as follows: symmetrical anchor plates with six large toothed holes; handle with one large hole and four or five small smooth holes along the edge of handle; anchor with smooth flukes, and about seven to 10 minutely tubercles on the middle of head.

Genus *Synaptula* Örsted, 1849

**23. *Synaptula recta* (Semper, 1868) (Fig. 4D)**

**Material examined.** 4 specimens, Weno Island intertidal, 12 Nov 2012; 5 specimens, Weno Island intertidal, 13 Nov 2012; 2 specimens, Weno Island intertidal, 15 Nov 2012; 2 specimens, Weno Island intertidal, 17 Nov 2012.

**Distribution.** Micronesia (Chuuk, Phonpei), Papua New Guinea, Guam, Vietnam, Philippines, Malaysia, Indonesia, northern Australia, Indo-West Pacific, Sri Lanka, Maldives Island, Ceylon, Red Sea.

Order Aspidochirotida Grube, 1840  
Family Holothuriidae Ludwig, 1894  
Genus *Actinopyga* Bronn, 1860

**24. *Actinopyga miliaris* (Quoy and Gaimard, 1834)**

**Material examined.** 1 specimen, Atoll diving-4, 19 Nov 2012.

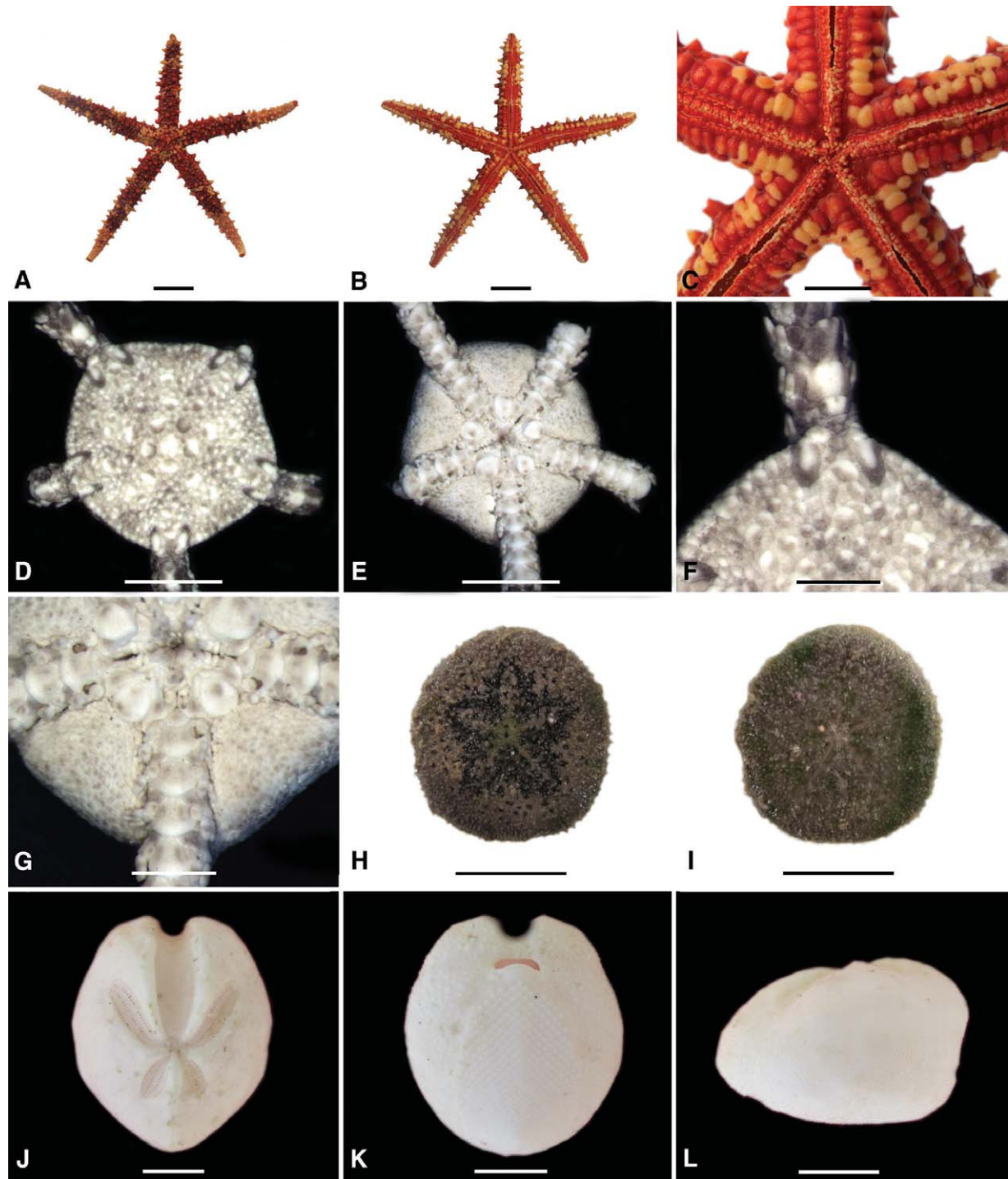
**Distribution.** Micronesia (Chuuk, Kosrae), Palau, New Caledonia.

Genus *Bohadschia* Jaeger, 1833

**25. *Bohadschia argus* Jaeger, 1833 (Fig. 4E)**

**Material examined.** 1 specimen, Atoll diving-4, 19 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), southern Japan,



**Fig. 3.** *Gomophia egyptiaca* (A–C), *Ophionereis porrecta* (D–G), *Laganum laganum* (H, I), *Schizaster lacunosus* (J–L). A, D, H, J, Dorsal side; B, E, I, K, Ventral side; C, G, Oral part; F, Radial shield and arm; L, Lateral side. Scale bars: A, B, H, I=2 cm, C=1 cm, D, E=2 mm, F, G=1 mm, J–L=1.5 cm.

southern China, Philippines, Guam, South Pacific, northern Australia, Indonesia, Bengal Bay.

## 26. *Bohadschia marmorata* Jaeger, 1833

**Material examined.** 1 specimen, Weno Island intertidal, 12

Nov 2012; 1 specimen, Weno Island intertidal, 15 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, South Pacific, northern Australia, Indo-West Pacific, Bengal Bay, eastern Africa, Red Sea.

Genus *Holothuria* Linnaeus, 1767

**27. *Holothuria (Halodeima) edulis* Lesson, 1830 (Fig. 4F)**

**Material examined.** 1 specimen, Sand Island diving, 14 Nov 2012; 1 specimen, Atoll diving-7, 20 Nov 2012; 1 specimen, Atoll diving-9, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), southern Japan, southern China, Philippines, Guam, South Pacific, northern Australia, Indonesia, Indo-West Pacific, Bengal Bay.

**28. *Holothuria (Mertensiothuria) hilla* Lesson, 1830**

**Material examined.** 3 specimens, Weno Island intertidal, 12 Nov 2012; 1 specimen, Mokumok Island diving, 13 Nov 2012; 3 specimens, Weno Island intertidal, 15 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), Korea (Korea Strait, Jeju Island), southern Japan, Guam, Hawaii, Australia, Indo-West Pacific, Africa (Zanzibar).

**29. *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835) (Fig. 4G)**

**Material examined.** 1 specimen, Mokumok Island diving, 13 Nov 2012; 1 specimen, Benedict diving, 13 Nov 2012; 1 specimen, Weno Island intertidal, 15 Nov 2012; 1 specimen, Atoll diving-6, 20 Nov 2012; 1 specimen, Xavier school diving, 22 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), southern China, Guam, Indo-West Pacific, West Indian Ocean, eastern Africa (Madagascar), Red Sea.

**30. *Holothuria (Semperothuria) flavomaculata* Semper, 1868 (Fig. 4H)**

**Material examined.** 1 specimen, Weno Island intertidal, 12 Nov 2012; 1 specimen, Weno Island intertidal, 13 Nov 2012.

**Distribution.** Micronesia (Chuuk, Yap), eastern Thailand, Philippines, Guam, South Pacific Islands, Australia, Indo-West Pacific, eastern Africa (Madagascar).

**31. *Holothuria (Stauropora) pervicax* Selenka, 1867**

**Material examined.** 1 specimen, Weno Island intertidal, 12 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae), Korea (Jeju Island), southern China, Philippines, Guam, Hawaii, South Pacific, northern Australia, Indo-West Pacific, Indian Ocean, eastern Africa, Red Sea.

Genus *Pearsonothuria* Levin, 1984

**32. *Pearsonothuria graeffei* (Semper, 1868) (Fig. 4I)**

**Material examined.** 1 specimen, Atoll diving-25, 16 Nov 2012; 1 specimen, Weno Island intertidal, 17 Nov 2012; 1 specimen, Atoll diving-5, 19 Nov 2012; 1 specimen, Atoll diving-7, 20 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern China, Philippines, Guam, Indo-West Pacific, Africa (Comoros, Madagascar), Red Sea.

Genus *Stichopus* Brandt, 1835

**33. *Stichopus horrens* Selenka, 1867 (Fig. 4J)**

**Material examined.** 2 specimens, Weno Island intertidal, 12 Nov 2012; 3 specimens, Weno Island intertidal, 17 Nov 2012.

**Distribution.** Micronesia (Chuuk, Kosrae, Yap), southern Japan, southern China, Philippines, Hawaii, South Pacific, northern Australia, Indonesia, Maldives Island.

**34. *Stichopus vastus* Sluiter, 1887 (Fig. 4K)**

**Material examined.** 1 specimen, Xavier school diving, 22 Nov 2012.

**Distribution.** Micronesia (Chuuk, Yap), Papua New Guinea, Palau Islands, Indonesia, northern Australia.

Genus *Thelenota* Brandt, 1835

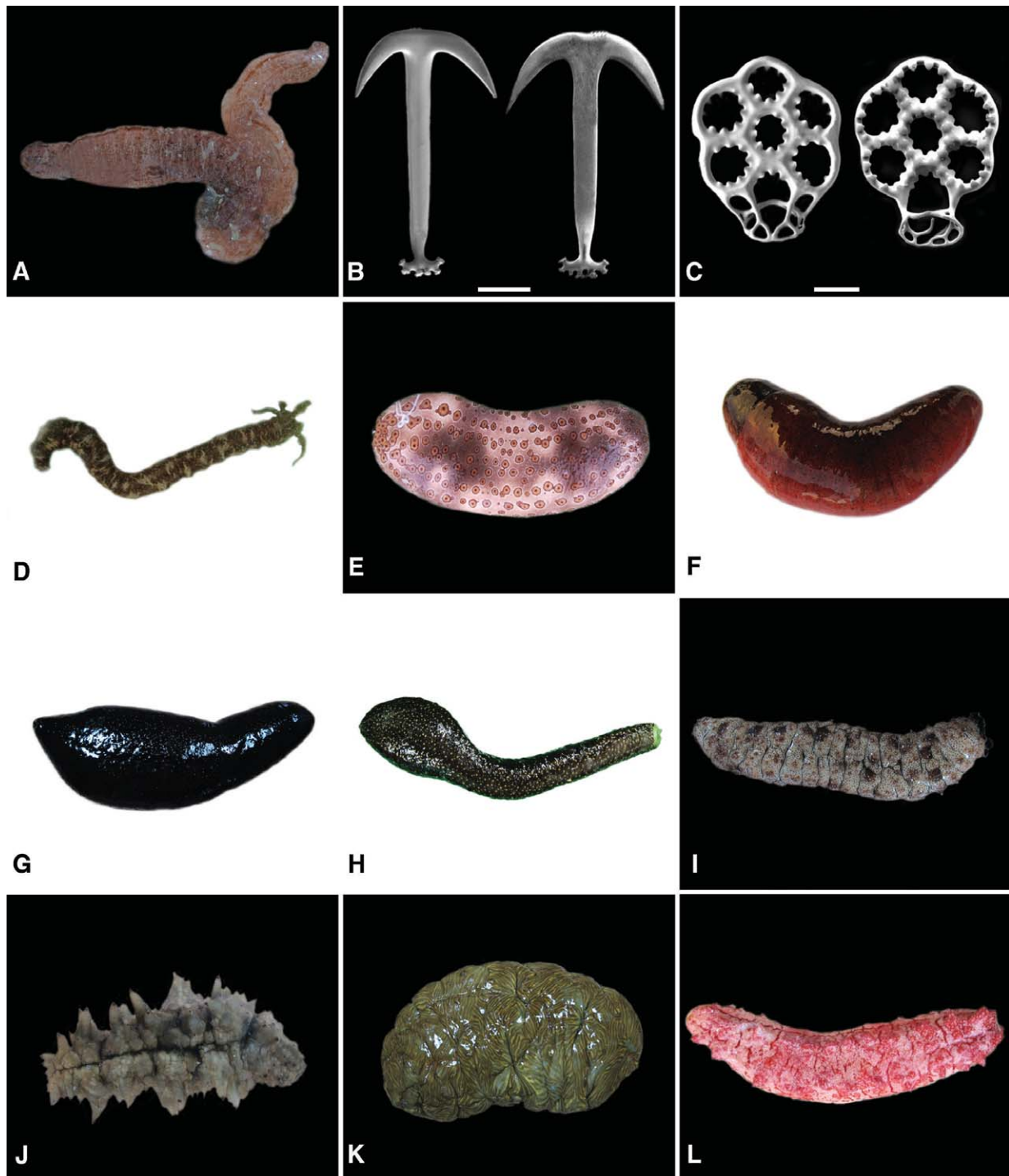
**\*35. *Thelenota anax* HL Clark, 1921 (Fig. 4L)**

*Thelenota anax* HL Clark, 1921: 185, Pl. 18 fig. 3; Liao, 1975: 205, fig. 6 (1-10); Cherbonnier, 1979: 9, fig. 5A-N; Liao, 1984: 222, 243; Féral and Cherbonnier, 1986: 100, figs 39, 40O; Massin and Lane, 1991: 57; Liao and AM Clark, 1995: 470, fig. 283a-d; Rowe and Gates, 1995: 327; Massin, 1999: 78, figs. 63a-k, 64; Paulay, 2014: 210915. *Stichopus variegatus* AM Clark, 1984: 88, fig. 2.

**Material examined.** 1 specimen, Atoll diving-1, 16 Nov 2012; 1 specimen, Atoll diving-5, 19 Nov 2012; 1 specimen, Atoll diving-10, 21 Nov 2012.

**Distribution.** Micronesia (Chuuk), Japan (Ryukyu Islands), southern China, Fiji, New Caledonia, Papua New Guinea, Marshall Islands, Guam, Palau Islands, South Pacific, nor-





**Fig. 4.** Holothuroids from Chuuk. A, *Opheodesoma spectabilis*; B, Anchors of body wall of *O. spectabilis*; C, Anchor plates of body wall of *O. spectabilis*; D, *Synaptula recta*; E, *Bohadschia argus*; F, *Holothuria (Halodeima) edulis*; G, *H. (Mertensiothuria) leucospilota*; H, *H. (Semerothuria) flavomaculata*; I, *Pearsonothuria graeffei*; J, *Stichopus horrens*; K, *S. vastus*; L, *Thelenota anax*. Scale bars: B, C=50  $\mu$ m.

thern Australia, Indonesia, Malaysia, Maldives Island, Madagascar.

**Remark.** This species has a unique body color and shape. Specimens have huge body sizes, and the longest length

reached about 49 cm.

## DISCUSSION

The echinoderm fauna of Micronesia was firstly reported by Kerr (1994) with regard to Holothuroidea in Kosrae. Kerr et al. (2007) investigated 19 locations of Yap over 2 weeks (27 Jul–9 Aug 2007) and reported 66 species, including 16 unidentified species: five crinoids (four unidentified), 14 asteroids (two unidentified), 14 echinoids (three unidentified), and 33 holothuroids (seven unidentified). Kerr et al. (2008) also surveyed 21 locations of Kosrae over two weeks (22 Feb–7 Mar 2008) and reported 74 species, including 20 unidentified species. KIOST (2009) recorded list of 20 echinoderms, six asteroids (one unidentified), two echinoids and 12 holothuroids (three unidentified), from Weno Island of Chuuk. Lee and Shin (2013) surveyed at eight intertidal areas and 12 SCUBA diving points of 10–50 m depths in the subtidal zone of Kosrae (23–30 Jan 2011 and 8–15 Jan 2012) and reported 50 species of three crinoids, 11 asteroids, seven ophiuroids, 10 echinoids, and 19 holothuroids, including 16 newly recorded species. Our faunistic study of echinoderms was performed at one intertidal site as well as 16 subtidal sites at depths of 8–40 m in Chuuk from 11–25 Nov 2012 (Table 1, Fig. 1). In total, 165 specimens were collected and classified as 35 species, excluding one unidentified species, and they were identified based on morphological characteristics. Seven echinoderms, including one asteroid (*L. laevigata*), one ophiuroid (*O. savignyi*), three echinoids (*M. globulus*, *E. mathaei*, and *S. lacunosus*), and two holothuroids [*H. (Mertensiothuria) hilla* and *H. (Stauropora) pervicax*] were also distributed at the Korea Strait and Jeju Island of Korea due to the warm Kuroshio Current. Holothuroids abundantly inhabited Chuuk, and *S. recta*, *H. (M.) hilla*, and *S. horrens* were particularly dominant species. *Mespilia globulus* and *P. gratiosa* were also dominant echinoids and inhabited rocky cracks at wide intertidal zone of Station 1 (Weno Island) (Table 1). We newly reported five echinoderms from Micronesia that have not been reported by Kerr (1994), Kerr et al. (2007, 2008), KIOST (2009), or Lee and Shin (2013): *Gomophia egyptiaca* Gray, 1840, *Ophionereis porrecta* Lyman, 1860, *Schizaster lacunosus* (Linnaeus, 1758), *Opheodesoma spectabilis* Fisher, 1907, and *Thelenota anax* (H.L. Clark, 1921). In addition, one unidentified ophiuroid (*Ophiothrix* sp.) needs to be identified for further verification.

## ACKNOWLEDGMENTS

This study was supported by the project titled “Development

of overseas marine biological resources and their utilization system” and a part of the Marine Biotechnology Program (MERBK; Marine Echinoderm Resource Bank of Korea) funded by the Ministry of Oceans and Fisheries, Korea.

## REFERENCES

- Agassiz A, 1879. Preliminary report on the Echini of the exploring expedition H.M.S. “Challenger”, Sir C. Wyville Thomson chief of civilian staff. Proceedings of the American Academy of Arts and Science, 14:182-261.
- Agassiz A, 1881. Report on the Echinoidea dredged by H.M.S. Challenger during the years 1873-75. Report of the Scientific Results of the Voyage of H.M.S. “Challenger” 1973-76, 3:1-321.
- Agassiz A, Clark HL, 1907. Preliminary reports on the Echini collected in 1906, from May to December, among the Aleutian Islands, in Bering Sea, and along the coasts of Kamchatka, Sakhalin, Korea, and Japan, by the U.S. Fish Commission Steamer “Albatross”. Bulletin of the Museum of Comparative Zoology at Harvard College, 51:109-139.
- Brock J, 1888. Die Ophiuriden fauna des indischen Archipels. Zeitschrift für Wissenschaftliche Zoologie, 47:465-539.
- Cherbonnier G, 1979. Description d'*Actinopyga flammea* nov. sp., et données nouvelles sur deux espèces connues d'Holothuries Aspidochirotes (Echinodermes). Bulletin Muséum National Histoire Naturelle Paris, 4 Série, 1:3-12.
- Clark AH, 1954. Records of Indo-Pacific Echinoderms. Pacific Science, 8:243-263.
- Clark AM, 1984. Echinodermata of the Seychelles. Monographiae Biologicae, 55:83-102.
- Clark AM, Rowe FWE, 1971. Monograph of shallow-water Indo-West Pacific echinoderm. Trustees of the British Museum (Natural History), London, pp. 1-238.
- Clark HL, 1917. Hawaiian and other Pacific Ocean Echini; the Spatangina; the Echinoneidae, Nucleolitidae, Urechinidae, Echinocorythidae, Calymnidae, Pourtalesidae, Palaeostomatidae, Aeropsidae, Palaeopneustidae and Spatangidae. Memoirs of the Museum of Comparative Zoology, 46:81-284.
- Clark HL, 1921. The echinoderm fauna of the Torres Strait. Papers from Department of Marine Biology of the Carnegie Institution of Washington, 10:1-223.
- Clark HL, 1924. The holothurians of the museum of Comparative Zoology. The Synaptinae. Bulletin of the Museum of Comparative Zoology at Harvard College, 65:457-501.
- Döderlein L, 1885. Seeigel von Japan und den Liu-Kiu Inseln. Archiv für Naturgeschichte Berlin, 51:73-112.
- Domantay JS, 1954. Some holothurians from Guam and vicinity. Natural Applied Science Bulletin University Philippines, 12: 336-357.
- Féral JP, Cherbonnier G, 1986. Guide des étoiles de mer, oursins et autres échinodermes du lagon de Nouvelle-Calédonie. Les holothurides. ORSTOM, Paris:55-107.

- Fisher WK, 1907. The holothurians of the Hawaiian Islands. *Proceedings of the United States National Museum*, 32:637-744.
- Fisher WK, 1919. Starfishes of the Philippine seas and adjacent waters. *Bulletin of the United States National Museum*, 3: 1-547.
- Gray JE, 1840. A synopsis of the genera and species of the class Hypostoma (*Asterias*, Linnaeus). *Annals of the Magazine of Natural History*, 6:275-290.
- Kerr AM, 1994. Shallow-water holothuroids (Echinodermata) of Kosrae, eastern Caroline islands. *Pacific Science*, 48:161-174.
- Kerr AM, Kim SW, Michonneau F, 2008. The shallow-water echinoderms of Kosrae. University of Guam Marine Laboratory Technical Report, 123:1-31.
- Kerr AM, Netchy KH, Hoffman SM, 2007. The shallow-water echinoderms of Yap. University of Guam Marine Laboratory Technical Report, 121:1-34.
- Korea Institute of Ocean Science and Technology (KIOST), 2009. Development of overseas marine bioresources and a system for their Utilization. Korea Institute of Ocean Science and Technology, Ansan, pp. 1-23.
- Kroh A, Mooi R, 2014. World Echinoidea database [Internet]. The world register of marine species (WoRMS), Accessed 27 Jan 2014, <<http://www.marinespecies.org/echinoidea>>.
- Lee T, Shin S, 2013. Echinoderm fauna of Kosrae, the Federation States of Micronesia. *Animal Systematics, Evolution and Diversity*, 29:1-17.
- Liao Y, 1975. The echinoderms of Xisha Islands. I. Holothuroidea, Guangdong province, China. *Studia Marina Sinica*, 10: 199-228.
- Liao Y, 1984. The aspidochirote holothurians of China. *Studia Marina Sinica*, 23:221-247.
- Liao Y, Clark AM, 1995. The echinoderms of southern China. Science Press, Beijing, New York, pp. 1-614.
- Linnaeus C, 1758. *Systema Naturae per Regna tria Naturae secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis, Editio decima reformata*; Tomus I. Laurentii, Sali, Holmiae, 8:1-824.
- Ljungman AV, 1867. Ophiuroidea viventia huc usque cognita enumerat. *Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar*, 24:303-336.
- Lyman T, 1860. Descriptions of new Ophiuridae, belonging to the Smithsonian Institution and to the Museum of Comparative Zoology at Cambridge. *Proceedings of the Boston Society of Natural History* 1859-61, 7:252-262.
- Mah C, 2014. World Asteroidea database [Internet]. The world register of marine species (WoRMS), Accessed 27 Jan 2014, <<http://www.marinespecies.org/asteroidea>>.
- Massin C, 1999. Reef-dwelling Holothuroidea (Echinodermata) of the Spermonde Archipelago (South-West Sulawesi, Indonesia). *Zoologische Verhandelingen*, 329:1-144.
- Massin C, Lane DJW, 1991. Description of a new species of sea cucumber (Stichopodidae, Holothuroidea, Echinodermata) from the eastern Indo-Malayan archipelago: *Thelenota rubralineata* n. sp. *Micronesica*, 24:57-64.
- Mortensen T, 1907. The Danish Ingolf-Expedition 1895-1896. Vol. 4. Echinoidea, pt. 2. Bianco Luno, Copenhagen, pp. 1-200.
- Mortensen T, 1951. A monograph of the Echinoidea, V, 2. Spatangoida II; Amphisternata II; the Spatangidae, Loveniidae, Pericosmidae, Schizasteridae, and Brissidae. C. A. Reitzel, Copenhagen, pp. 1-593.
- Paulay G, 2014. The world register of marine species (WoRMS) [Internet]. Accessed 27 Jan 2014, <<http://www.marinespecies.org>>.
- Rehman HU, Nakaya H, Kawai K, 2013. Geological origin of the volcanic islands of the Caroline group in the Federated States of Micronesia, western Pacific. *South Pacific Studies*, 33:101-118.
- Rho BJ, Shin S, 1981. A systematic study on the echinoderms in Korea. *Journal of Korean Research Institute for Better Living*, Ewha Womans University, 28:21-53.
- Rowe FWE, Gates J, 1995. Echinodermata. In: *Zoological catalogue of Australia* (Ed., Wells A). Vol. 33. CSIRO Australia, Melbourne, pp. 1-510.
- Shin S, 2011. Invertebrate Fauna of Korea. Vol. 32. Sea Urchins: Echinodermata: Echinozoa: Echinoidea. National Institute of Biological Resources, Incheon, pp. 1-122.
- Starmer JA, 2003. An annotated checklist of ophiuroids (Echinodermata) from Guam. *Micronesica*, 35-36:547-562.
- Stöhr S, 2011. New records and new species of Ophiuroidea (Echinodermata) from Lifou, Loyalty Islands, New Caledonia. *Zootaxa*, 3089:1-50.
- Stöhr S, O'Hara T, 2014. World Ophiuroidea database [Internet]. The world register of marine species (WoRMS), Accessed 27 Jan 2014, <<http://www.marinespecies.org/ophiuroidea>>.
- Tortonese E, 1977. Report on echinoderms from the gulf of Aquaba (Red Sea). *Monitore Zoologico Italiano*, 9:273-290.
- Yamaguchi M, 1975. Coral-reef asteroids of Guam. *Biotropica*, 7:12-23.

Received February 17, 2014  
Revised April 13, 2014  
Accepted April 14, 2014